



Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS

FOR

COMPACTION WITH MOISTURE CONTROL FOR EMBANKMENT CONSTRUCTION

Effective Date
October 21, 2003

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

01031.01 DESCRIPTION.

Compaction with Moisture Control shall consist of placement and compaction of embankment materials at the required moisture content as shown in the contract documents. It shall be the responsibility of the Contractor to test and insure the moisture content of soil being placed under Compaction with Moisture Control is within the specified range.

01031.02 MATERIAL.

Compaction with Moisture Control is required for all embankment placed with Class 10 Excavation (Suitable and Unsuitable) and all Selected Backfill. Soils classified as Unsuitable Class 10 Excavation shall be placed within embankments as directed in Standard Road Plan RL-1B for Type A, B, or C disposal. The soils placed with compaction with moisture control may be select, Class 10, or unsuitable.

01031.03 CONSTRUCTION.

A. Quality Control Program (Embankment Construction).

The Contractor shall provide and maintain a Quality Control Program (Embankment Construction), defined as all activities of sampling, testing, and process control inspection, and necessary adjustments for construction of compaction operations for embankments to meet the requirements of these Developmental Specifications.

As part of the Quality Control Program (Embankment Construction), the Contractor shall provide a Quality Control Technician to perform testing on all embankment soils placed with Compaction with Moisture Control. As a minimum, the Quality Control Technician shall have a high school education and experience in earthwork construction. The Technician shall obtain 'Grade Technician Lab Certification' through a 1 day course held at Des Moines Area Community College (DMACC) in Boone through the Technical Training and Certification Program (TTCP) of the Iowa DOT. Training

shall be arranged through the Iowa DOT, Office of Construction, by calling (515) 239-1280. TTCP requirements of Materials I.M. 213 shall apply.

The Quality Control Technician shall be present on the project when embankment is being placed with Compaction with Moisture Control. ~~A separate Quality Control Technician shall be provided for each contract.~~

B. Test Procedures.

All test procedures and equipment shall conform to applicable Materials I.M.'s, ~~Iowa DOT Materials Laboratory Test Methods,~~ or equivalent standards of AASHTO or ASTM.

Equivalent standards shall be subject to review by the Engineer and mutually agreed upon by the Engineer and Contractor.

~~The method for Proctor compaction shall be Materials I.M. 309, which is a modification of AASHTO Test T 99-81. Samples shall be taken at a minimum of 3 different locations. A minimum of three points shall be used to determine the Proctor curve.~~

Acceptable test methods for determining moisture content are:

Oven drying	AASHTO T 265
Pan drying	ASTM D 4959 AASHTO T 265 modified to use an open burner
Microwave	ASTM D 4643
Nuclear gauge	Materials I.M. 334

AASHTO T 265 oven drying method shall be the reference method for calibration.

Minimum sample size is 1 pound (450 g) ~~for moisture content by ASTM D 4959 or ASTM D 4643.~~

~~Optimum moisture and field moisture content shall be calculated and reported to the nearest 0.1%.~~

C. Embankment Construction.

1. General.

Section 2107 of the Standard Specifications shall apply except when amended by requirements of these Developmental Specifications. Embankment placed with moisture control shall meet requirements of Article 2107.09 of the Standard Specifications.

2. Moisture Control.

The Contractor shall determine the optimum moisture content by Proctor testing of soil being placed. Optimum moisture shall be determined for each type of excavated or mixed soil which varies as to change the expected AASHTO classification, or when directed by the Engineer.

With the approval of the Engineer, and for soils that can be identified during excavation, the Contractor may use the optimum moisture content as shown on the soils 'Q' sheets in the contract documents. In lieu of using values from the 'Q' sheets, the Contractor may choose to determine optimum moisture from a field sample.

If the Engineer deems the optimum moisture of material being excavated and/or mixed is not represented by that shown on the 'Q' sheets, optimum moisture shall be determined by the Contractor from a field sample.

When determined from a field sample at the option of the Contractor or as requested by the Engineer, the optimum moisture value from the field sample shall prevail over that shown on the 'Q' sheets.

It shall be the responsibility of the Contractor to test and insure that moisture content of material placed under the item 'Compaction with Moisture Control' is within the optimum range for the soil being placed. The allowable upper and lower ranges from optimum moisture control limits for field moisture content of embankment material will be shown in the contract documents. For alternate borrows or materials unforeseen during design, ranges shall be determined by the Iowa DOT, Office of Design, Soils Section. The Engineer will be responsible for determining the optimum moisture content of the soil being placed.

If, after initial disking to break down lumps greater than 0.3 m as required by Article 2107.04, 3, of the Standard Specifications, the deposited soil material contains moisture in excess of the specified moisture limits, disking to reduce excess moisture shall be done.

If, after initial disking as required by Article 2107.04, 3, of the Standard Specifications, the material is dry to the extent that it is not within the range of the optimum moisture of the soil to allow satisfactory compaction by rolling, the material shall be moistened uniformly to the required limits before it is compacted.

Aeration, watering, and compaction operations shall proceed in an orderly fashion without unreasonable and unnecessary delay. Compensation will not be allowed for delays occasioned by the ordering of moistening or disking.

All soil accepted for final placement shall be within the specified moisture control limits.

The Contractor may choose to test moisture in compacted lifts using the nuclear gauge method instead of testing uncompacted material as per Article 2107.09 of the Standard Specifications. Immediate re-tests by nuclear gauge may be done after an initial failing test. The value used for acceptance of the lot shall be the average of the initial test and any successive re-tests. Initial tests which fail from apparent error or malfunction of equipment will be discounted by the Engineer.

3. Compaction.

Article 2107.05, Type A Compaction, of the Standard Specifications shall apply.

4. Equipment

Article 2107.02 of the Standard Specifications shall apply, except that pneumatic tired rollers as described in Articles 2001.05, C and 2001.05, D of the Standard Specifications, or self-propelled vibratory rollers as described in Article 2001.05, F of the Standard Specifications, shall be used for compaction of granular sand soils classified as AASHTO A-1, A-2, or A-3; and having 15% or less combined silt/clay content (percent passing the No. 200 (75 μ m sieve).

D. Test Frequency During Embankment Construction.

Moisture content of Class 10 Excavation and Selected Backfill shall be tested at a minimum frequency of once per excavated volume of 2000 cubic yards (1500 m^3) if material is from the same source. When the material source changes, a new test shall be required. If the source of excavation and moisture have been consistent and within moisture control limits, testing of each lift by Article 2107.09 of the Standard Specifications may be waived for areas of less than 2000 cubic yards (1500 m^3), or for embankment placed as median dikes (Standard Road Plan RL-4) or safety dikes (Standard Road Plan RL-7): one test per lift per 1500 feet (450 m) of roadway, for a maximum compacted volume of 1300 cubic yards (1000 m^3).

E. Field Records.

The Contractor shall document all observations, records and inspection, changes in soil type, soil moisture, fill placement procedures, and test results on a weekly basis. The results of the observations and records of inspection shall be noted in a permanent field record as they occur. Copies of field moisture tests shall be provided to the Engineer on a weekly basis. The original

testing records (raw field and lab data sheets) and control charts shall be provided to the Engineer in a neat and orderly manner within 5 calendar days after completion of the project.

F. Control Charts.

Standardized control charts for field moisture shall be maintained by the Contractor for each grading area. The charts shall be posted at a location agreed upon by the Contractor and Engineer. Test results obtained by the Contractor shall be recorded on the control charts on the same day that tests are conducted. The results of assurance tests by the Engineer shall also be recorded on the standardized control charts.

Individual test points shall be plotted by the Contractor. The Contractor's test data shall be shown as black (filled) circles. A moving average of four tests is optional; if plotted it shall be shown as unfilled circles. Assurance tests or retests shall be plotted as crosses (+). Other means of chart plotting may be used when approved by the Engineer. Legends used on the control charts shall be consistent throughout the project.

Refer to Figure 1 at the end of these Developmental Specifications for an example of a Control Chart.

G F. Corrective Action.

1. Moisture Content.

The Contractor shall notify the Engineer when a moisture content falls outside the specified control limits. If a field single moisture content falls outside of the control limits, the fill material in this area shall be considered unacceptable for compaction. The Contractor shall perform corrective action(s) to bring the uncompacted fill material, after a retest, within the specified moisture control limits. If material has been compacted, it shall be disked, brought within moisture control limits, and recompacted.

2. Incorrect Data.

If the Contractor's initial moisture content is within control limits, but later discovery of an error results in a corrected moisture content point falling outside of the control limits, compacted fill represented by and placed after sampling shall be considered unacceptable.

H G. Iowa DOT Quality Assurance.

1. Required Testing.

The Contractor's Quality Control Technician shall perform all field testing and data analysis. The Quality Control Technician shall retain split samples when requested by the Engineer. The Engineer may select any or all of the Contractor-retained split samples for assurance testing.

The Engineer will determine the frequency and location of assurance tests. Assurance test results will be provided to the Contractor within 1 working day after the Contractor's quality control test results have been reported.

The Engineer will periodically witness field testing being performed by the Contractor. If the Engineer observes the quality control field tests are not being performed in accordance with the applicable test procedures, the Engineer may stop production until corrective action is taken. The Engineer will notify the Contractor of observed deficiencies, promptly, both verbally and in writing. The Engineer will document all witnessed testing.

All assurance tests shall be part of the project files.

2. Testing Precision.

Differences between the Contractor's and Engineer's field moisture content tests will be acceptable if moisture content is within 1.5% based on dry weight (mass) of soil. The sample for

the Engineer's assurance test will be taken from a split sample at the exact location of the Contractor's quality control test.

Differences between the Contractor's and Engineer's Proctor compaction results will be acceptable if optimum dry density is within 5 pounds per cubic foot (80 kg/m³) and optimum moisture is within 1.5% based on dry weight (mass) of soil.

~~Samples for the Engineer's assurance tests will be taken from a split sample at the exact location of the Contractor's quality control test.~~

In the event that comparison test results are outside the above allowable differences, the Engineer will investigate the reason immediately. The Engineer's investigation may include testing of other locations, observations of the Contractor's testing procedures and equipment, and comparison of test results of the Contractor with those of the Engineer.

3. Referee Testing.

If a difference in procedures for sampling and testing and/or test results exists between the Contractor and the Engineer which they cannot resolve, the Iowa DOT Central Materials Laboratory or another mutually agreed upon independent testing laboratory will be asked to provide referee testing. The Engineer and the Contractor will abide by the results of the referee testing. The party found in error will pay service charges incurred for referee testing by an independent laboratory.

H. Acceptance.

The Engineer will base final acceptance of tests and materials on the results of the Contractor's quality control testing as verified by the Engineer's quality assurance.

01031.04 METHOD OF MEASUREMENT.

~~The quantity of embankment requiring Compaction with Moisture Control, in cubic yards (cubic meters), will be the quantity shown in the contract documents.~~

All excavation in preparation for and construction of embankment with moisture control will be included in Class 10 Excavation ~~and Selected Backfill~~ in accordance with Article 2102.13 of the Standard Specifications. ~~The construction of embankments with moisture control will not be measured separately for payment except as follows:~~

A. Compaction with Moisture Control.

~~The quantity of Compaction with Moisture Control, in cubic yards (cubic meters), will be the quantity shown in the contract documents from dimensions of the roadbed cross section. The total will be the in-place volume of Class 10 fill and the in-place volume of Selected Backfill.~~

B. Quality Control Program (Embankment Construction).

~~The item will be the lump sum for the Quality Control Program (Embankment Construction).~~

01031.05 BASIS OF PAYMENT.

~~The Contractor will be paid the contract unit price for Compaction with Moisture Control, in cubic yards (cubic meters), for the quantity of embankment placed with moisture control. This payment shall be full compensation for furnishing a Quality Control Technician, sampling and testing, process control inspection, working of drying material, furnishing and applying water, controlling moisture content of the materials, and compacting the materials, as specified.~~

A. Compaction with Moisture Control.

~~The Contractor will be paid the contract unit price for Compaction with Moisture Control per cubic yard (cubic meter). This payment shall be full compensation for the working of drying material.~~

furnishing and applying water, controlling moisture content of the materials, and compacting the materials, as specified.

D. Quality Control Program (Embankment Construction).

The Contractor will be paid the contract lump sum price for Quality Control Program (Embankment Construction). The furnishing of a Quality Control Technician during construction shall be included in the item for Quality Control Program (Embankment Construction). This shall include all labor, sampling and testing, and process control inspection to meet the requirements of these Developmental Specifications.

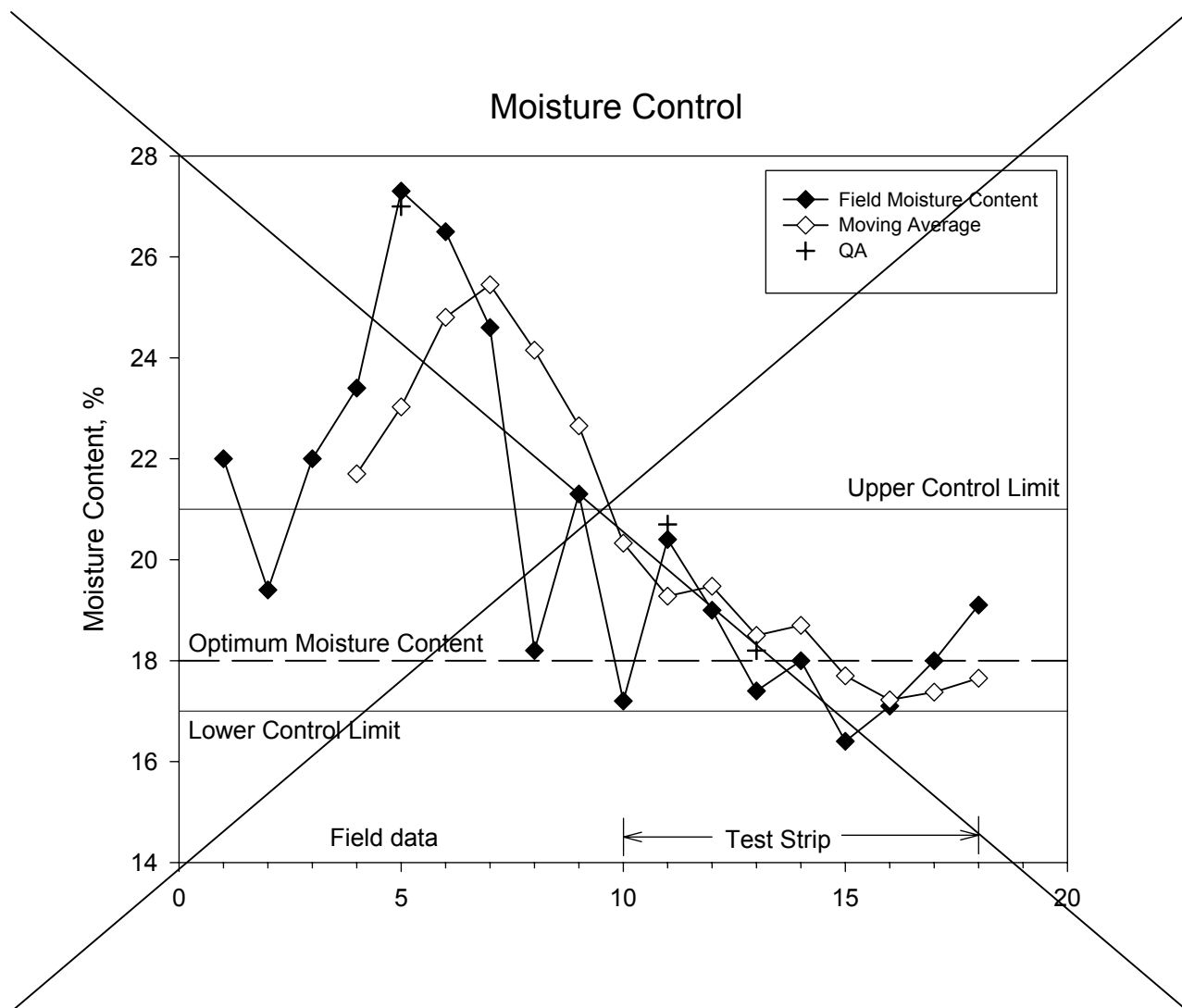


Figure 1. Moisture control